8279 – STUDY CARD

1. INTRODUCTION

Electro Systems Associates Private Limited (ESA) manufactures trainers for most of the popular microprocessors viz 8085, Z-80, 8031 8086/88, 68000 and 80196. ESA offers a variety of modules, which can be interfaced, to these trainers. These modules can be effectively used for teaching/training in the Laboratories.

The 8279 Study Card incorporates Intel's 8279. The interface is designed to study the features available in 8279.

Functional description of 8279, implementation of the circuit and some sample programs for different trainers are presented in this Manual.

2. DESCRIPTION OF THE CIRCUIT:

The 8279 Study Card provides 6 nos of 8-Digit Seven Segment Display and 4 x 4 Matrix Hex Keypad. The keypad includes shift and control keys for key scanning option. User can find the design details about the keypad and display interface to 8279 in Appendix B Schematics.
The study card has got two 26-Pin (J3 & J4) connectors and a 50-Pin (P1) connector for interfacing with different trainers. The details about 8279 (i.e. programming 8279 and pin details etc.) are presented in the next section.
Jumpers are provided on the study card for encode and decode modes of operation of 8279.

For decode method:

Place the jumpers as follows:

JP1 = 1 2
JP2 = 2 3
JP3 = 2 3
JP4 = 1 2
JP5 = 2 3

For encode method:

Place the jumpers as follows:

JP1 = OPEN
JP2 = 1 2
JP3 = 1 2
JP4 = 2 3
JP5 = 1 2

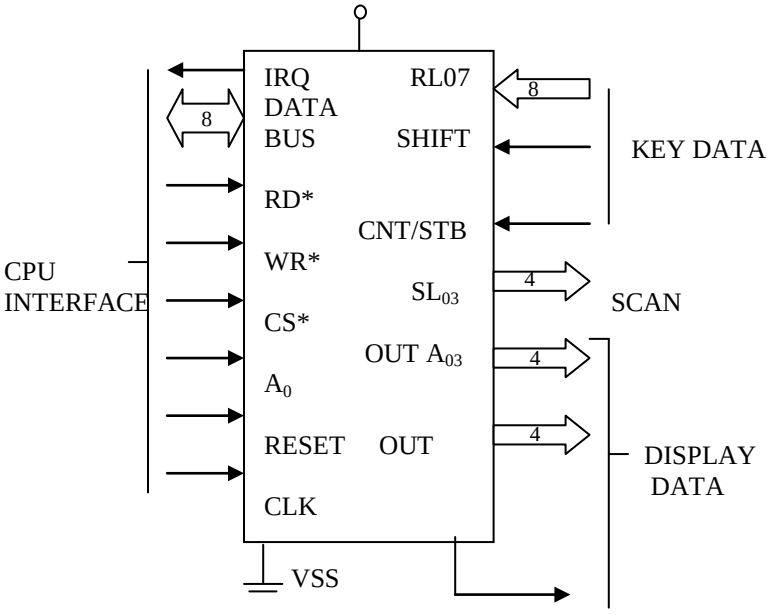
8279/8279-5

PROGRAMMABLE KEYBOARD/DISPLAY INTERFACE

THEORY:

- **MCS-85 ™ Compatible 8279-5**
- **Simultaneous Keyboard Display Operations**
- **Scanned Keyboard Mode**
- **Scanned Sensor Mode**
- **Strobed Input Entry Mode**
- **8-Character Keyboard FIFO**
- **2-Key Lockout or N-Key Rollover with Contact Debounce**
- **Dual 8-or 16-Numerical Display**
- **Single 16-Character Display**
- **Right or Left Entry 16-Byte Display RAM**
- **Mode Programmable from CPU**
- **Programmable Scan Timing**
- **Interrupt Output on Key Entry**

The Intel* 8279 is a general-purpose programmable keyboard and display I/O interface device designed for use with Intel* microprocessors. The keyboard portion can provide a scanned interface to a 64-contact key matrix. The keyboard portion will also interface to an array of sensors or a strobed interface keyboard, such as the hall effect and ferrite variety. Key depressions can be 2-key lockout or N-key rollover. Keyboard entries are debounced and strobed in an 8-character FIFO. If more than 8 characters are entered, overrun status is set. Key entries set the interrupt output line to the CPU.
The display portion provides a scanned display interface for LED, incandescent, and other popular display technologies. Both numeric and alphanumeric segment displays may be used as well as simple indicators. The 8279 have 16x8 display RAM, which can be organized into dual 16x4. The RAM can be loaded or interrogated by the CPU. Both right entry, calculator and left entry typewriter display formats are possible. Both read and write of the display RAM can be done with auto-increment of the display RAM address.



HARDWARE DESCRIPTION:

The 8279 is packaged in a 40 pin DIP. The following are the functional description of each pin.

Pin Descriptions:

Symbol	Pin No	Name and Function
DB_0-DB_7	12 to 19	**Bi-directional data bus:** All data and commands between the CPU and the 8279 are transmitted on these lines.
CLK	3	**Clock:** Clock from system used to generate internal timing.
RESET	9	**Reset:** A high signal on this pin resets the 8279. After being reset the 8279 is placed in the following mode: 1. 16 8-bit character display-left entry. 2. Encoded scan keyboard-2 key lockout. Along with this the program clock prescaler is set to 31.
CS*	22	**Chip Select:** A low on this pin enables the interface functions to receive or transmit.
A_0	21	**Buffer Address:** A high on this line indicates the signals in or out are interpreted as a command or status. A low indicates that they are data.
RD*, WR*	10, 11	**Input / Output Read and Write:** These signals Enable the data buffers to either send data to the external bus or receive it from the external bus.
IRQ	4	**Interrupt Request:** In a keyboard mode, the interrupt line is high when there is data in the FIFO/Sensor RAM. The interrupt line goes low with each FIFO/Sensor RAM read and returns high if there is still information in the RAM. In a sensor mode, the interrupt line goes high whenever a change in a sensor is detected.
V_{ss}, V_{cc}	20, 40	**Ground and power supply pins.**
$SL_0 - SL_3$	32 to 35	**Scan Lines:** Scan lines, which are used to scan the key switch or sensor matrix and the display digits. These lines can be either encoded (1 of 16) or decoded (1 of 4).
RL_0-RL_7	38, 39, 1, 2, 5, 6, 7, 8	**Return Line:** Return line inputs which are connected to the scan lines through the keys or sensor switches. They have active internal pull-ups to keep them high until a switch closure pulls one low. They also serve as an 8-bit input. In the Strobed Input mode.
SHIFT	36	**Shift:** The shift input status is strobed along with the key position on key closure in the Scanned keyboard modes. It has an active Internal pull up to keep it high until a switch closure pulls it low.
CNTL/ STB	37	**Control / Strobed Input Mode:** For keyboard modes this line is used as a control input and stored like status on a key closure. The line is also the strobe line that enters the data into the FIFO in the Strobed Input mode.
OUT A_0-A_3 OUT B_0-B_3	27,26,25, 24 31,30,29, 28	**Outputs:** These two ports are the outputs for the 16 x 4 display refresh registers. The data from these outputs is synchronized to the scan lines (SL_0-SL_3) for multiplexed digit displays. The two 4 bit ports may be blanked independently. These two ports may also be considered as one 8-bit port.
BD*	23	**Blank Display:** This output is used to blank the display during digit switching or by a display blanking command.

FUNCTIONAL DESCRIPTION:

Since data input and display are an integral part of many microprocessor designs, the system designer needs an interface that can control these functions without placing a large load on the CPU. The 8279 provide this function for 8-bit microprocessors.

The 8279 have two sections: keyboard and display. The keyboard section can interface to regular typewriter style keyboards or random toggle or thumb switches. The display section drives alphanumeric displays or a bank of indicator lights. Thus the CPU is relieved from scanning the keyboard or refreshing the display.

The 8279 is designed to directly connect to the microprocessor bus. The CPU can program all operating modes for the 8279. These modes include.

Input Modes:

- Scanned keyboard – with encoded (8 x 8 key keyboard) or decoded (4 x 8 key keyboard) scan lines. A key depression generates a 6-bit encoding of key position. Position and shift and control status are strobed in the FIFO. Keys are automatically debounced with 2-key lockout or N-key rollover.

- Scanned Sensor Matrix- with encoded (8 x 8 matrix switches) or decoded (4 x 8 matrix switches) scan lines. Key status (open or closed) stored in RAM addressable by CPU.

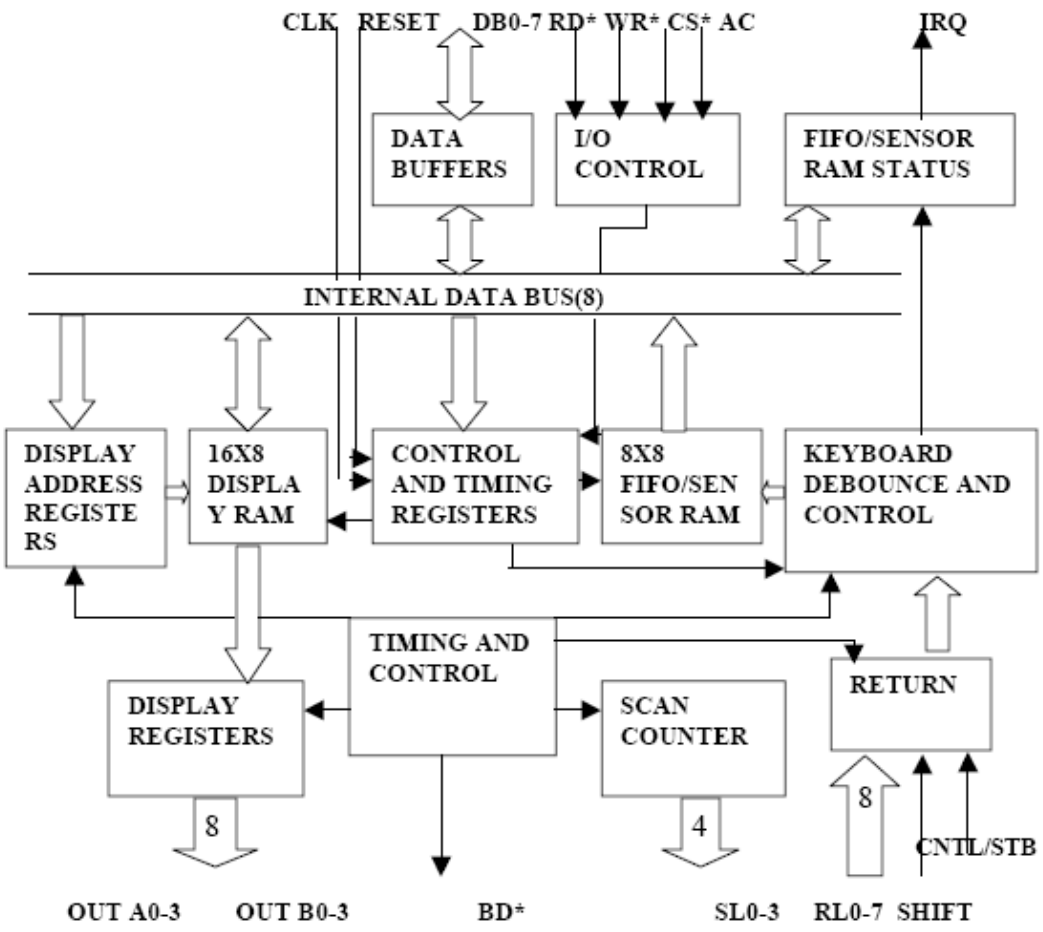
- Strobed Input – Data on return lines during control line strobe is transferred to FIFO.

Output Modes:

- 8 or 16 character multiplexed displays that can be organized as dual 4-bit or single 8-bit (B_0-D_0, A_3=D_7).
- Right entry or left entry display formats.
- Other features of the 8279 include.
- Mode programming from the CPU.
- Clock prescaler.
- Interrupt output to signal CPU when there is keyboard or sensor data available.
- An 8 byte FIFO to store keyboard information.
- 16-byte internal Display RAM for display refreshes. The CPU can also read this RAM.

PRINCIPLES OF OPERATION

The following is a description of the major elements of the 8279 Programmable keyboard/Display interface device. Refer to the block diagram in Figure 3.



INTERNAL BLOCK DIAGRAM OF 8279

I/O Control and Data Buffer

The I/O control section uses the CS*, A_0, RD* and WR* lines to control data flow to and from the various internal registers and buffers. All data flow to and from the 8279 is enabled by CS*. The character of the information, given or desired by the CPU, is identified by A_0. A logic one means the information is a command or status. A logic zero means the information is data. RD* and WR* determine the direction of data flow through the Data Buffers. The Data Buffers are bi-directional buffers that connect the internal bus to the external bus. When the chip is not selected (CS* = 1), the devices are in a high impedance state. The drivers input during WR*, CS* and output during RD*.CS*

Control and Timing Registers and Timing Control

These registers store the keyboard and display modes and other operating conditions programmed by the CPU. The modes are programmed by presenting the proper command on the data lines with A_0=1 and then sending a WR*. The command is latched on the rising edge of WR*.

The command is then decoded and the appropriate function is set. The timing control contains the basic timing counter chain. The first counter is a ÷ N prescaler that can be programmed to yield an internal frequency of 100 kHz that gives a 5.1 ms keyboard scan time and a 10.3 ms debounce time. The other counters divide down the basic internal frequency to provide the proper key scan, row scan, keyboard matrix scan, and display scan times.

Scan Counter

The scan counter has two modes. In the encoded mode, the counter provides a binary count that must be externally decoded to provide the scan lines for the keyboard and display. In the decoded mode, the scan counter decodes the least significant 2 bits and provides a decoded 1 of 4 scan. Note then when the keyboard is in decoded scan, so is the display. This means that only the first 4 characters in the Display RAM are displayed.

In the encoded mode, the scan lines are active high outputs. In the decoded mode, the scan lines are active low outputs.

Returns Buffers and Keyboard Debounce and Control

The 8 return lines are buffered and latched by the Return Buffers. In the keyboard mode, these lines are scanned, looking for key closures in that row. If the debounce circuit detects a closed switch, it waits about 10ms to check if the switch remains closed. If it does, the address of the switch in the matrix plus the status of SHIFT and CONTROL are transferred to the FIFO. In the scanned Sensor Matrix modes, the contents of the return lines are directly transferred to the corresponding row of the Sensor RAM (FIFO) each key scan time. In Strobed input mode, the contents of the return lines are transferred to the FIFO on the rising edge of the CNTL/STB line pulse.

FIFO/Sensor RAM and Status

This block is a dual function 8 x 8 RAM. In keyboard or Strobed input modes, it is a FIFO. Each new entry is written into successive RAM positions and each is then read in order of entry. FIFO status keeps track of the number of characters in the FIFO and whether it is full or empty. Too many reads or writes will be recognized as an error. The status can be read by an RD* with CS* low and A high. The status logic also provides an IRQ signal when the FIFO is not empty. In Scanned Sensor Matrix mode, the memory is a Sensor RAM. Each row of the Sensor RAM is loaded with the status of the corresponding row of sensor in the sensor matrix. In this mode, IRQ is high if a change in a sensor is detected.

Display Address Registers and Display RAM

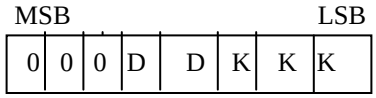
The Display Address Registers hold the address of the word currently being displayed. The read/write address is programmed by CPU command. They also can be set to auto increment after each read or write. The Display RAM can be directly read by the CPU after the correct mode and address is set. The addresses for the A and B nibbles are automatically updated by the 8279 to match data entry by the CPU. The A and B nibbles can be entered independently or as one word according to the mode that is set by the CPU Data entry to the display can be set to either left or right entry see Interface Considerations for details.

SOFTWARE OPERATION

8279 commands

The following commands program the 8279 operating modes. The commands are sent on the Data Bus with CS* low and A_0 high and are loaded to the 8279 on the rising edge of WR*.

Keyboard/Display Mode Set



Where DD is the Display Mode and KKK is the keyboard Mode.

DD*

0 0 8 8-bit character display - Left entry.

0 0 16 8-bit character display – Left entry.

1 0 8 8-bit character display – Right entry.

1 1 16 8-bit character display – Right entry.

For description of right and left entry. See interface considerations. Note that when decoded scan is set in keyboard mode, the display is reduced to 4 characters independent of display mode set.

KKK*

0 0 0 Encoded scan keyboard – 2 key Lockout*

0 0 1 Decoded Scan keyboard – 2 key Lockout.

0 1 0 Encoded Scan keyboard – N-key Rollover

0 1 1 Decoded Scan keyboard – N-key Rollover

1 0 0 Encoded Scan Sensor Matrix

1 0 1 Decoded Scan Sensor Matrix

1 1 0 Strobed input, Encoded Display Scan

1 1 1 Strobed Input, Decoded Display Scan.

Program Clock

	MSB							LSB
Code	0	0	1	P	P	P	P	P

All timing and multiplexing signals for the 8279 are generated by an internal prescaler. This prescaler divides the external clock (pin 3) by a programmable integer. Bits PPPPP determine the value of this integer, which ranges from 2 to 31. Choosing a divisor that yields 100 kHz will give the specified scan and debounce times. For instance, if pin 3 of the 8279 is being clocked by a 2 MHz signal, PPPPP should be set to 10100 to divide the clock by 20 to yield the proper 100 kHz operating frequency.

Read FIFO/Sensor RAM

Code	0	1	0	A_I	X	A	A	A

x = Don't Care

The CPU sets up the 8279 for a read of the FIFO/Sensor RAM by first writing this command. In the Scan keyboard Mode; the Auto-increment flag (AI) and the RAM address bits (AAA) are irrelevant. The 8279 will automatically drive the data bus for each subsequent read (A_0=0) in the same sequence in which the data first entered the FIFO. All subsequent reads will be from the FIFO until another command is issued.

In the sensor Matrix Mode, the RAM address bits AAA select one of the 8 rows of the Sensor RAM. If the AI flag is set (AI = 1), each successive read will be from the subsequent row of the sensor RAM.

Read Display RAM

Code	0	1	1	A_I	A	A	A	A

The CPU sets up the 8279 for a read of the Display RAM by first writing this command. The address bits AAAA select one of the 16 rows of the Display RAM. If the AI flag is set (A_I = 1), this row address will be incremented after each following read or write to the Display RAM. Since the same counter is used for both reading and writing, this command sets the next read or write address and the sense of the Auto-increment mode for both operations.

Write Display RAM

Code	1	0	0	A_I	A	A	A	A

The CPU sets up the 8279 for a write to Display RAM by first writing this command. After writing the command with A_0 = 1, all subsequent writes with A_0 = 0 will be to the Display RAM. The addressing and Auto-increment functions are identical to those for the Read Display RAM. However, this command does not affect the source of subsequent Data Reads; the CPU will read from whichever RAM (Display or FIFO/Sensor) which was last specified. If, indeed, the Display RAM was last specified, the Write Display RAM will, nevertheless, change the next Read location.

Display Write Inhibit/Blanking

					A	B	A	B
Code	1	0	1	X	IW	IW	BL	BL

The IW bits can be used to mask nibble A and nibble B in applications requiring separate 4-bit display ports. By setting the IW flag (IW=1) for one of the ports, the port becomes marked so that entries to the Display RAM from the CPU do not affect that port. Thus, if each nibble is input to a BCD decoder, the CPU may write a digit to the Display RAM without affecting the other digit being displayed. It is important to note that bit B_0 corresponds to bit D_0 on the CPU bus, and that bit A_3 corresponds to bit D_7.

If the user wishes to blank the display, the BL flags are available for each nibble. The last Clear command issued determines the code to be used as a "blank". This code defaults to all zeros after a reset. Note that both BL flags must be set to blank a display formatted with a single 8-bit port.

Clear

Code	1	1	0	C_D	C_D	C_D	C_F	C_A

The C_D bits are available in this command to clear all rows of the Display RAM to a selectable blanking code as follows:

C_D	C_D	
0	X	All Zeros (X = Don't Care)
1	0	AB = Hex 20 (0010 0000)
1	1	All Ones

Enable clear display when = 1 (or by C_A = 1)

During the time the Display RAM is being cleared (~ 160 us), it may not be written to. The most significant bit of the FIFO status word is set during this time. When the display RAM becomes available again, it automatically resets.

If the C_F bit is asserted (C_F = 1), the FIFO status is cleared and the interrupt output line is reset. Also, the Sensor RAM pointer is set to row 0.

C_F, the Clear All bit, has the combined effect of C_D and C_F; it uses the C_D clearing code on the Display RAM and also clears FIFO status. Furthermore, it resynchronizes the internal timing chain.

End Interrupt/Error Mode Set

Code	1	1	1	E	X	X	X	X

X = Don't care

For the sensor matrix modes this command lowers the IRQ line and enables further writing into RAM. (The IRQ line would have been raised upon the detection of a change in a sensor value. This would have also inhibited further writing into the RAM until reset).
For the N-key rollover mode – if the E bit is programmed to "1" the chip will operate in the special Error mode. (For further details, see Interface Considerations Section).

Status Word

The status word contains the FIFO status, error, and display unavailable signals. This word is ready by the CPU when A_0 is high and CS* and RD* are low. See interface considerations for more detail on status word.

Data Read

Data is read when A_0 CS* and RD* are all low. The source of the data is specified by the Read FIFO or Read Display commands. The trailing edge of RD* will cause the address of the RAM being read to be incremented if the Auto-Increment flag is set. FIFO reads always increment (if no error occurs) independent of A_I.

Data Write

Data that is written with A_0, CS* and WR* low is always written to the Display RAM. The address is specified by the latest Read Display or Write Display command. Auto-Incrementing on the rising edge of WR* occurs if A_I set by the latest display command.

INTERFACE CONSIDERATIONS

Scanned Keyboard Mode, 2-key Lockout

There are three possible combinations of conditions that can occur during debounce scanning. When a key is depressed , the debounce logic is set. Other depressed keys are looked for during the next two scans. If none are encountered, it is a single key depression and the key position is entered into the FIFO along with the status of CNTL and SHIFT lines. If the FIFO was empty, IRQ will be set to signal the CPU that there is an entry in the FIFO. If the FIFO was full, the key will not be entered and the error flag will be set. If another closed switch is encountered, no entry to the FIFO can occur. If all other keys are released before this one, then it will be entered to the FIFO. If this key is released before any other, it will be entirely ignored. A key is entered to the FIFO only once per depression, no matter how many keys were pressed along with it or in what order they were released. If two keys are depressed within the debounce cycle, it is a simultaneous depression. Neither key will be recognized until one key remains depressed alone. The last key will be treated as a single key depression.

Scanned Keyboard Mode, N-Key Rollover

With N-key Rollover each key depression is treated independently from all others. When a key is depressed, the debounce circuit waits 2 keyboard scans and then checks to see if the key is still down. If it is, the key is entered into the FIFO. If a simultaneous depression occurs, the keys are recognized and entered according to the order the keyboard scan found them.

Scanned Keyboard – Special Error Modes

For N-key rollover mode the user can program a special error mode. This is done by the "End Interrupt/Error Mode Set" command. The debounce cycle and key-validity check are as in normal N-key mode. If during a single debounce cycle, two keys are found depressed, this is considered a simultaneous multiple depression, and sets an error flag. This flag will prevent any further writing in to the FIFO and will set interrupt (if not yet set). The error flag could be read in this mode by reading the FIFO STATUS word. (See "FIFO STATUS: for further details). The error flag is reset by sending the normal CLEAR command with $C_F = 1$.

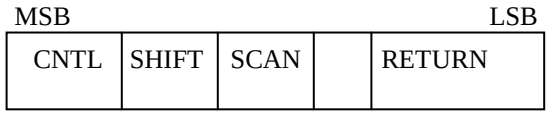
Sensor Matrix Mode

In Sensor Matrix mode, the debounce logic is inhibited. The status of the sensor switch is inputted directly to the Sensor RAM. In this way the Sensor RAM keeps an image of the state of the switches in the sensor matrix. Although debouncing is not provided, this mode has the advantage that the CPU knows how long the sensor was closed and when it was realized. A keyboard mode can only indicate a validated closure. To make the software easier, the designer should functionally group the sensors by row since this is the format in which the CPU will read them, since this is the format in which the CPU will read them. The IRQ line goes high if any sensor value change is detected at the end of a sensor matrix scan. The IRQ line is cleared by the first data read operation if the Auto-Increment flag is set to zero, or by the End interrupt command if the Auto-increment flag is set to one.

Note: Multiple changes in the matrix addressed by (SL_0-3 = 0) may cause multiple interrupts (SL_0 =0 in the Decoded Mode). Reset may cause the 8279 to see multiple changes.

Data Format

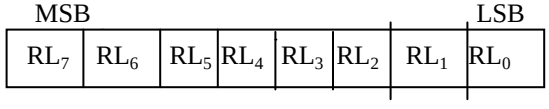
In the Scanned Keyboard mode, the character entered into the FIFO corresponds to the position of the switch in the keyboard plus the status of the CNTL and SHIFT lines (non-inverted). CNTL is the MSB of the character and SHIFT is the next most significant bit. The next three bits are from the scan counter and indicate the row the key was found in. The last three bits are from the column counter and indicate to which return line the key was connected.



SCANNED KEYBOARD DATA FORMAT

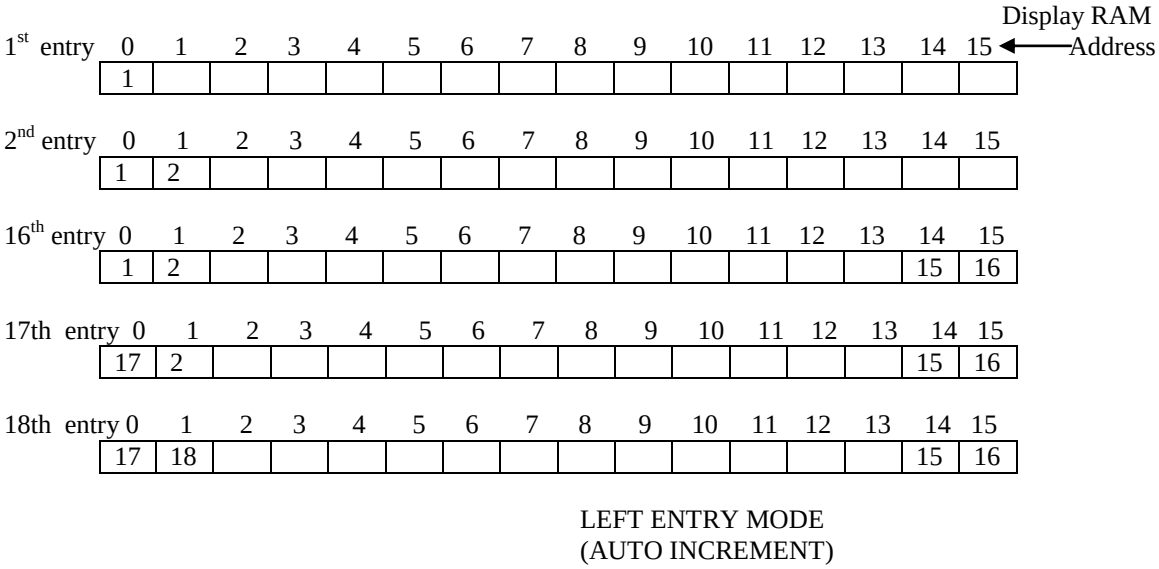
In Sensor Matrix mode, the data on the return lines is entered directly in the row of the Sensor RAM that corresponds to the row in matrix being scanned. Therefore each switch position maps directly to Sensor RAM position. The SHIFT and CNTL inputs are ignored in this mode. Note that switches are not necessarily the only things that can be connected to the return lines in this mode. Any logic that can be triggered by the scan lines can enter data to the return line inputs. Eight multiplexed input ports could be tied to the return lines and scanned by the 8279.

In Strobed input mode, the data is also entered to the FIFO from the return lines. The data is entered by the rising edge of a CNTL/STB line pulse. Data can come from another encoded keyboard or simple switch matrix. The return lines can also be used as a general-purpose strobed input.



Display
Left Entry

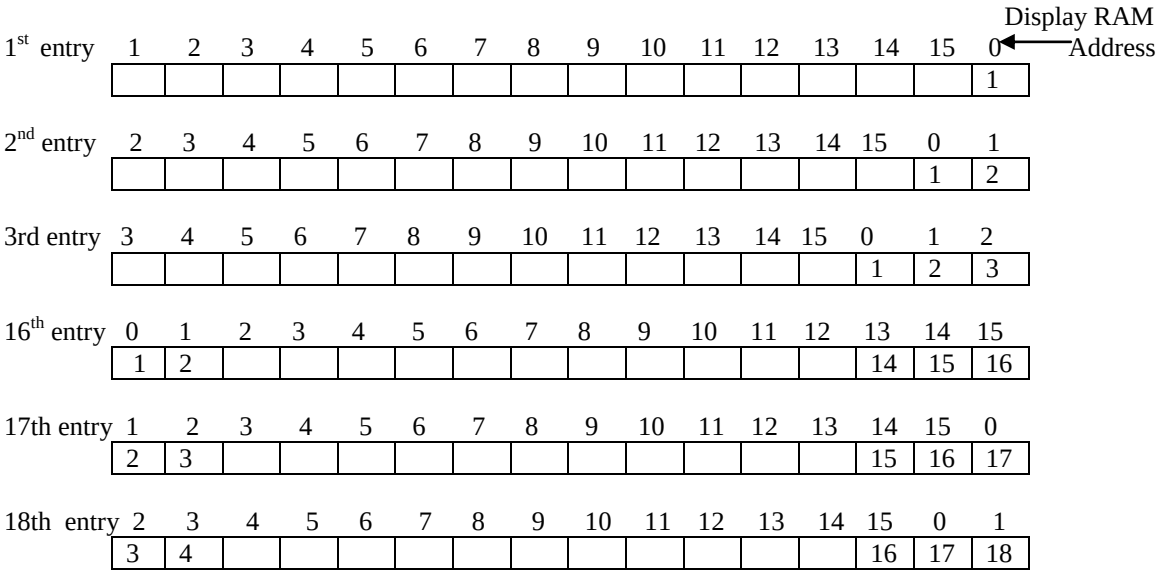
Left Entry mode is the simplest display format in that each display position directly corresponds to a byte or nibble in the Display RAM. Address 0 in the RAM is the left-most display character and address 15 (or address 7 in 8 character display) is the right most display character. Entering characters from position zero causes the display to fill from the left. The 17th (9th) character is entered back in the left most position and filling again proceeds from there.



LEFT ENTRY MODE
(AUTO INCREMENT)

Right Entry

Right entry is the method used by most electronic calculators. The first entry is placed in the right most display character. The next entry is also placed in the right most character after the displays shifted left one character. The left most character is shifted off the end and is lost.

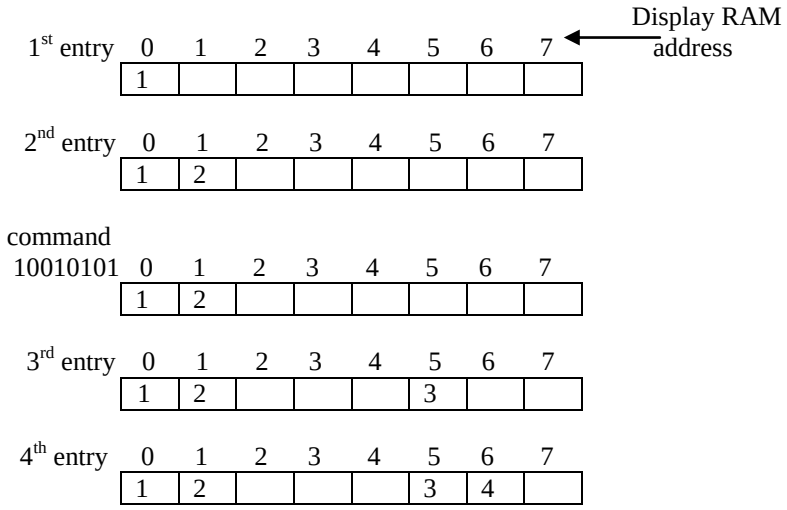


RIGHT ENTRY MODE
(AUTO INCREMENT)

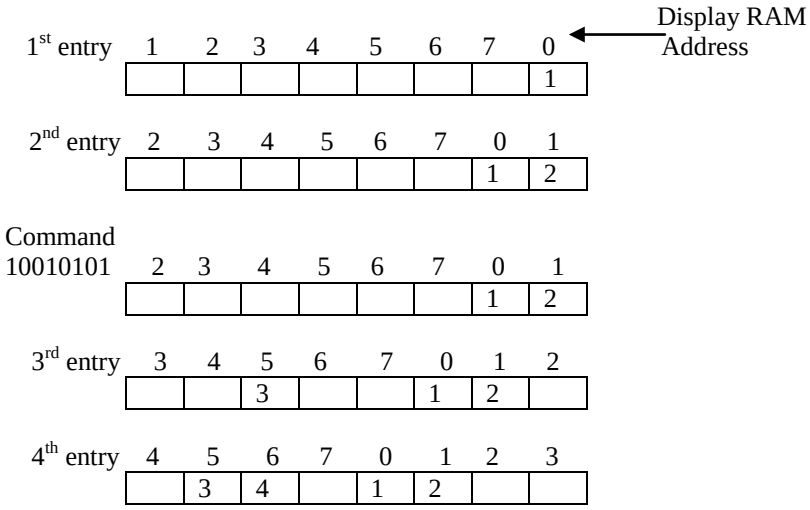
Note that now the display position and register address do not correspond. Consequently, entering a character to an arbitrary position in the Auto Increment mode may have unexpected results. Entry starting at Display RAM address 0 with sequential entry is recommended.

Auto Increment

In the Left Entry mode, Auto Incrementing causes the address where the CPU will next write to be incremented by one and the character appears in the next location. With non-Auto Incrementing the entry is both to the same RAM address and display position. Entry to an arbitrary address in the Auto Increment mode has no undesirable side effects and the result is predictable.

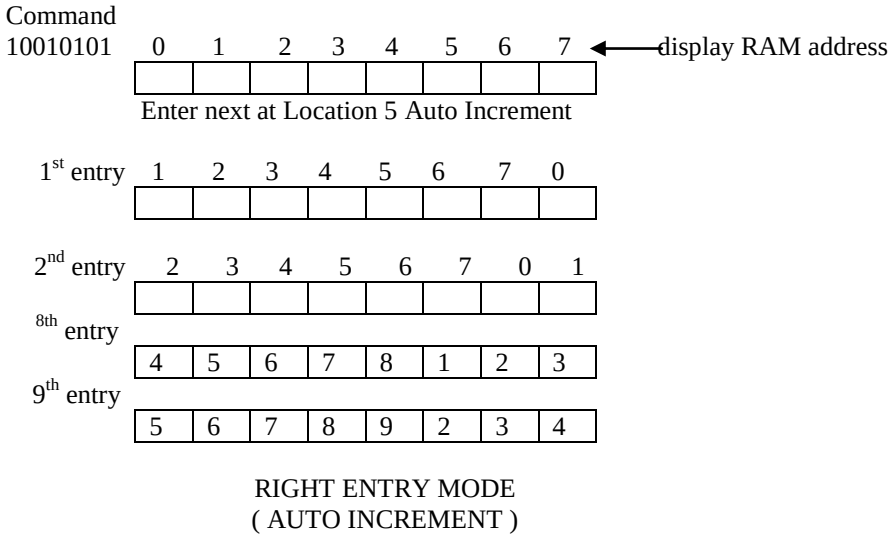


In the Right Entry mode, Auto Incrementing and non Incrementing have the same effect as in the Left Entry except if the address sequence is interrupted.



RIGHT ENTRY MODE
(AUTO INCREMENT)

Stating at an arbitrary location operates as shown below:


Command
10010101
0 1 2 3 4 5 6 7
display RAM address
Enter next at Location 5 Auto Increment
1st entry 1 2 3 4 5 6 7 0
2nd entry 2 3 4 5 6 7 0 1
8th entry
4 5 6 7 8 1 2 3
9th entry
5 6 7 8 9 2 3 4

RIGHT ENTRY MODE
(AUTO INCREMENT)

Entry appears to be from the initial entry point.

8/16 Character Display Formats

If the display mode is set to an 8-character display, the on duty-cycle is double what it would be for a 16-character display (e.g. 5.1 ms scan time for 8 characters vs. 10.3 ms for 16 characters with 100 kHz internal frequency).

G.FIFO Status

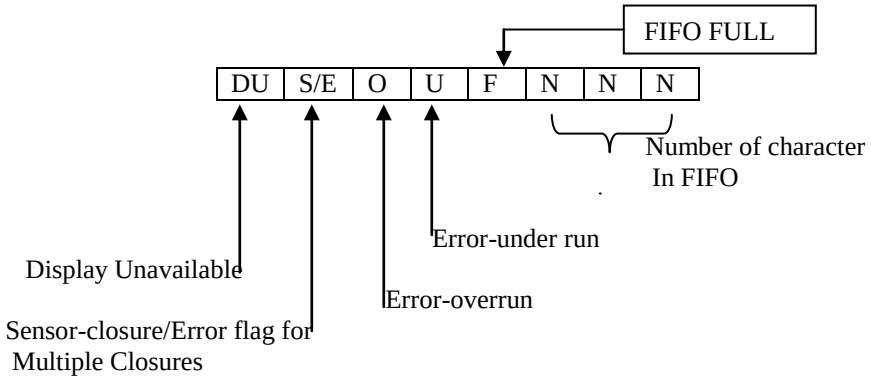
FIFO status is used in the Keyboard and Strobed input modes to indicate the number of characters in the FIFO and to indicate whether an error has occurred. There are two types of errors possible: overrun and under run. Overrun occurs when the entry of another character into a full FIFO is attempted. Under run occurs when the CPU tries to read an empty FIFO.

The FIFO status word also has a bit to indicate that the Display RAM was unavailable because a Clear Display or Clear All command had not completed its clearing operation.

In a Sensor Matrix mode, a bit is set in the FIFO status word to indicate that at least one sensor closure indication is contained in the Sensor RAM.

In Special Error Mode the S/E bit is showing the error flag and serves as an indication to whether a simultaneous multiple closure error has occurred.

FIFO STATUS WORD



3.0 INSTALLATION AND CONFIGURATION

The Connector details for connecting the Study Card to different Trainers are mentioned below.

TRAINER	CONNECTORS ON TRAINER	CONNECTORS ON STUDY CARD ADAPTER		CONNECTORS ON STUDY CARD
MPS 85-3	J3 (26 PIN) J4 (26 PIN)	- -		J3 (26 PIN) J4 (26 PIN)
ESA 85-2	P1 (50 PIN)	-		P1 (50 PIN)
ESA 86/88-2/3 *	J1 (50 PIN) J2 (50 PIN)	J1 (50 PIN) J2 (50 PIN)	J3 (26 PIN) J4 (26 PIN)	J3 (26 PIN) J4 (26 PIN)
ESA 86E	J6 (26 PIN) J7 (26 PIN)			J3 (26 PIN) J4 (26 PIN)
ESA 31/51 *	J5(50 PIN)	J1(50 PIN)	J3(26 PIN) J4(26 PIN)	J3 (26 PIN) J4 (26 PIN)
ESA51E VER.3 *	J4(50 PIN)	P3(50 PIN)	P1(26 PIN) P2(26 PIN)	J3 (26 PIN) J4 (26 PIN)
ESA 51E VER.4	J4 (26 PIN) J6 (26 PIN)			J3 (26 PIN) J4 (26 PIN)

* External Study Card Adapter is required to connect the Study Card with the Trainer

Connect the Study Card by following the above-mentioned connectors with FRCs respectively.

Switch Off Power to the Trainer while connecting the Study Card. Press Reset after giving power to the Trainer.

4. DEMONSTRATION PROGRAMS FOR 8085 SERIES KITS

4A. DEMONSTRATION PROGRAMS FOR MPS 85-3 TRAINER KIT

The following program initializes 8279 in decode mode to display the message " –ESA PVT LTD." on Seven Segment Display.

```
CMD_PORT        EQU     81H
DATA_ PORT      EQU     80H
```

ADDRESS	OPCODE	LOOP	MNEMONIC	COMMENTS
			ORG 8000H	
8000	06 08		MVI B, 08H	; Routine to clear all the 7 Segment
8002	3E 00		MVI A, 00H	; Display.
8004	D3 81		OUT 81H	
8006	3E 90		MVI A, 90H	
8008	D3 81		OUT 81H	
800A	3E 00	CLEAR :	MVI A, 00H	
800C	D3 80		OUT 80H	
800E	05		DCR B	
800F	78		MOV A,B	
8010	FE 00		CPI 00H	
8012	C2 0A 80		JNZ CLEAR	; 8 8 bit character display
8015	3E 01		MVI A, 01H	
8017	D3 81		OUT 81H	; Left entry, Decoded scan keyboard
8019	3E 90		MVI A, 90H	
801B	D3 81	BEGIN :	OUT 81H	
801D	06 04		MVI B, 04H	
801F	21 00 81		LXI H, DISTBLI	; Look up table to display
8022	7E		MOV A, M	; "-ESA".
8023	D3 80	BACK :	OUT 80H	
8025	CD 73 80		CALL DELAY	; Provide some delay.
8028	23		INX H	
8029	05		DCR B	
802A	78		MOV A, B	
802B	FE 00		CPI 00	
802D	C2 22 80		JNZ BACK	
8030	CD 73 80		CALL DELAY	
8033	CD 73 80		CALL DELAY	
8036	3E 90		MVI A, 90H	
8038	D3 81		OUT CMD_PORT	
803A	06 04		MVI B, 04H	
803C	21 05 81		LXI H, DISTBL2	; Look up table to display
803F	7E		MOV A, M	; "PVT:.
8040	D3 80	BACK1 :	OUT 80H	
8042	CD 73 80		CALL DELAY	
8045	23		INX H	
8046	05		DCR B	
8047	78		MOV A, B	
8048	FE 00		CPI 00	
804A	C2 3F 80		JNZ BACK1	
804D	CD 73 80		CALL DELAY	
8050	CD 73 80		CALL DELAY	

ADDRESS	OPCODE	LABLE	MNEMONIC	COMMENTS
8053	3E 90		MVI A, 90H	
8055	D3 81		OUT CMD-PORT	
8057	06 04		MVI B, 04H	
8059	21 0A 81		LXI H, DISTBL3	; Look up table to display
805C	7E	BACK2:	MOV A, M	; "LTD".
805D	D3 80		OUT 80H	
805F	CD 73 80		CALL DELAY	
8062	23		INX H	
8063	05		DCR B	
8064	78		MOV A, B	
8065	FE 00		CPI 00	
8067	C2 5C 80		JNZ BACK2	
806A	CD 73 80		CALL DELAY	
806D	CD 73 80		CALL DELAY	
8070	C3 19 80		JMP BEGIN	
8073	11 FF FF	DELAY:	LXI D, 0FFFFH	; Delay Routine.
8076	1B	REP:	DCX D	
8077	7A		MOV A, D	
8078	B3		ORA E	
8079	C2 76 80		JNZ REP	
807C	C9		RET	
807D				
			ORG 8100H	
8100	04 97 D6 77 00		DISTBL1:- ESA	
8105	00 37 E3 87 00		DISTBL2: PVT	
810A	00 83 87 E5 00		DISTBL3 : LTD.	

1. Program to Display ELECTRO-SYSTEMS on Seven Segment Display using Encode method.

```
CMD_PORT        EQU     81H
DATA_ PORT      EQU     80H
```

ADDRESS	OPCODE	LOOP	MNEMONIC	COMMENTS
			ORG 8000H	
8000	06 08		MVI B, 08H	; Routine to clear all the 7 Segment
8002	3E 00		MVI A, 00H	; Display.
8004	D3 81		OUT 81H	
8006	3E 90		MVI A, 90H	
8008	D3 81		OUT 81H	
800A	3E 00	CLEAR :	MVI A, 00H	
800C	D3 80		OUT 80H	
800E	05		DCR B	
800F	78		MOV A,B	
8010	FE 00		CPI 00H	
8012	C2 0A 80		JNZ CLEAR	
8015	3E 10		MVI A, 10H	; 8 8 bit character display

8017	D3 81		OUT CMD_PORT	; Right entry.
8019	3E 90	BEGIN :	MVI A, 90H	
801B	D3 81		OUT CMD_PORT	
801D	06 08		MVI B, 08H	
801F	21 00 81		LXI H, DISTBL	; Look up table to display
8022	7E	BACK :	MOV A, M	; “ELECTRO-”.
8023	D3 80		OUT 80H	
8025	CD 4A 80		CALL DELAY	; Provide some delay.
8028	23		INX H	
8029	05		DCR B	
802A	78		MOV A, B	
802B	FE 00		CPI 00	
802D	C2 22 80		JNZ BACK	
8030	3E 90		MVI A, 90H	
8032	D3 81		OUT CMD_PORT	
8034	06 08		MVI B, 08H	
8036	21 08 81		LXI H, DISTBL+8	; Look up table to display ; “SYSTEMS”.
8039	7E	BACK1 :	MOV A, M	
803A	D3 80		OUT 80H	; Delay Routine.
803C	CD 4A 80		CALL DELAY	
803F	23		INX H	
8040	05		DCR B	
8041	78		MOV A, B	
8042	FE 00		CPI 00	
8044	C2 39 80		JNZ BACK1	
8047	C3 19 80		JMP BEGIN	
804A	11 FF FF		LXI D, 0FFFFH	
804D	1B	DELAY:	DCX D	
804E	7A	REP:	MOV A, D	
804F	B3		ORA E	
8050	C2 4D 80		JNZ REP	
8053	C9		RET	
8054				

ADDRESS	**OPCODE**	**LABLE**	**MNEMONIC**	**COMMENTS**
			ORG 8100H	
8100	97 83 97 93 87		DISTBL: ELECTRO-	
8105	13 F3 04		SYSTEMS.	
8108	D6 E6 D6 87 97			
810D	73 DE 00			

2. Program to scan the hex keypad and to display on Seven Segment Display using encode method.

```
CMD_PORT        EQU        81H
DATA_ PORT      EQU        80H
```

ADDRESS	OPCODE	LABLE	MNEMONIC	COMMENTS
8000	3E 00		MVI A, 00H	
8002	D3 81		OUT 81H	
8004	3E 90		MVI A, 90H	
8006	D3 81		OUT 81H	
8008	0E 08		MVI C, 08H	
800A	3E 00	CLEAR:	MVI A, 00H	; To clear all the digits.
800C	D3 80		OUT 80H	
800E	0D		DCR C	
800F	79		MOV A, C	
8010	FE 00		CPI 00H	
8012	C2 0A 80		JNZ CLEAR	
8015	DB 81	BACK:	IN 81H	; Read 8279 status.
8017	E6 07		ANI 07H	; is character available.
8019	CA 15 80		JZ BACK	
801C	21 00 81		LXI H, DISTBL	
801F	3E 40		MVI A, 40H	; Read FIFO.
8021	D3 81		OUT 81H	
8023	DB 80		IN 80H	
8025	E6 1F		ANI IFH	; Mask shift and control keys.
8027	6F		MOV L, A	
8028	3E 94		MVI A, 94H	; Address to display 0.
802A	D3 81		OUT 81H	
802C	3E F3		MVI A, 0F3H	; Address to display scanned
802E	D3 80		OUT 80H	; value.
8030	3E 95		MVI A, 95H	
8032	D3 81		OUT 81H	
8034	7E		MOV A, M	
8035	D3 80		OUT 80H	
8037	C3 15 80		JMP BACK	
8100	F3 60 B5 F4 66		DISTBL: 0 1 2 3	
8105	D6 D7 70 F7		4 5 6 7	
8109	76 77 C7 93 E5		8 9 A B	
810E	97 17 00		C D E F.	
8111	76 77 C7 93 E5			
8116	97 17 0			

4B. DEMONSTRATION PROGRAMS FOR ESA 85-2 TRAINER KIT

1. Program to Display –ESA PVT LTD. On Seven Segment Display using encode method.

```
CMD_PORT        EQU     81H
DATA_ PORT      EQU     80H
```

ADDRESS	OPCODE	LOOP	MNEMONIC	COMMENTS
			ORG 8000H	
8000	06 08		MVI B, 08H	; Routine to clear all the 7 Segment
8002	3E 00		MVI A, 00H	; Display.
8004	D3 81		OUT 81H	
8006	3E 90		MVI A, 90H	
8008	D3 81		OUT 81H	
800A	3E 00	CLEAR :	MVI A, 00H	
800C	D3 80		OUT 80H	
800E	05		DCR B	
800F	78		MOV A,B	
8010	FE 00		CPI 00H	
8012	C2 0A 80		JNZ CLEAR	
8015	3E 01		MVI A, 01H	; 8 8 bit character display
8017	D3 81		OUT CMD_PORT	; Left entry, Encoded scan keyboard
8019	3E 90	BEGIN :	MVI A, 90H	
801B	D3 81		OUT CMD_PORT	
801D	06 04		MVI B, 04H	
801F	21 00 81		LXI H, DISTBLI	; Look up table to display
8022	7E	BACK :	MOV A, M	; "-ESA".
8023	D3 80		OUT 80H	
8025	CD 73 80		CALL DELAY	; Provide some delay.
8028	23		INX H	
8029	05		DCR B	
802A	78		MOV A, B	
802B	FE 00		CPI 00	
802D	C2 22 80		JNZ BACK	
8030	CD 73 80		CALL DELAY	
8033	CD 73 80		CALL DELAY	
8036	3E 90		MVI A, 90H	
8038	D3 81		OUT CMD_PORT	
803A	06 04		MVI B, 04H	
803C	21 05 81		LXI H, DISTBL2	; Look up table to display
803F	7E	BACK1 :	MOV A, M	; "PVT:.
8040	D3 80		OUT 80H	
8042	CD 73 80		CALL DELAY	
8045	23		INX H	
8046	05		DCR B	
8047	78		MOV A, B	
8048	FE 00		CPI 00	
804A	C2 3F 80		JNZ BACK1	
804D	CD 73 80		CALL DELAY	
8050	CD 73 80		CALL DELAY	

ADDRESS	OPCODE	LABLE	MNEMONIC	COMMENTS
8053	3E 90		MVI A, 90H	
8055	D3 81		OUT CMD-PORT	
8057	06 04		MVI B, 04H	
8059	21 0A 81		LXI H, DISTBL3	; Look up table to display
805C	7E	BACK2:	MOV A, M	; "LTD".
805D	D3 80		OUT 80H	
805F	CD 73 80		CALL DELAY	
8062	23		INX H	
8063	05		DCR B	
8064	78		MOV A, B	
8065	FE 00		CPI 00	
8067	C2 5C 80		JNZ BACK2	
806A	CD 73 80		CALL DELAY	
806D	CD 73 80		CALL DELAY	
8070	C3 19 80		JMP BEGIN	
8073	11 FF FF	DELAY:	LXI D, 0FFFFH	; Delay Routine.
8076	1B	REP:	DCX D	
8077	7A		MOV A, D	
8078	B3		ORA E	
8079	C2 76 80		JNZ REP	
807C	C9		RET	
807D				
			ORG 8100H	
8100	04 97 D6 77 00		DISTBL1:- ESA	
8105	00 37 E3 87 00		DISTBL2: PVT	
810A	00 83 87 E5 00		DISTBL3 : LTD.	

2. Program to Display ELECTRO-SYSTEMS on Seven Segment Display using decode method.

CMD_PORT EQU 81H
DATA_ PORT EQU 80H

ADDRESS	OPCODE	LOOP	MNEMONIC	COMMENTS
			ORG 8000H	
8000	06 08		MVI B, 08H	; Routine to clear all the 7 Segment
8002	3E 00		MVI A, 00H	; Display.
8004	D3 81		OUT 81H	
8006	3E 90		MVI A, 90H	
8008	D3 81		OUT 81H	
800A	3E 00	CLEAR :	MVI A, 00H	
800C	D3 80		OUT 80H	
800E	05		DCR B	
800F	78		MOV A,B	
8010	FE 00		CPI 00H	
8012	C2 0A 80		JNZ CLEAR	
8015	3E 10		MVI A, 10H	; 8 8 bit character display
8017	D3 81		OUT CMD_PORT	; Right entry.

8019	3E 90	BEGIN :	MVI A, 90H	
801B	D3 81		OUT CMD_PORT	
801D	06 08		MVI B, 08H	
801F	21 00 81		LXI H, DISTBL	; Look up table to display
8022	7E	BACK :	MOV A, M	; “-ESA”.
8023	D3 80		OUT 80H	
8025	CD 4A 80		CALL DELAY	; Provide some delay.
8028	23		INX H	
8029	05		DCR B	
802A	78		MOV A, B	
802B	FE 00		CPI 00	
802D	C2 22 80		JNZ BACK	
8030	3E 90		MVI A, 90H	
8032	D3 81		OUT CMD_PORT	
8034	06 08		MVI B, 08H	
8036	21 08 81		LXI H, DISTBL+8	; Look up table to display
		BACK1 :	MOV A, M	; “PVT:.
8039	7E		OUT 80H	
803A	D3 80		CALL DELAY	; Delay Routine.
803C	CD 4A 80		INX H	
803F	23		DCR B	
8040	05		MOV A, B	
8041	78		CPI 00	
8042	FE 00		JNZ BACK1	
8044	C2 39 80		JMP BEGIN	
8047	C3 19 80		RET	
804A	C9	DELAY:	LXI D, 0FFFFH	
804D	11 FF FF	REP:	DCX D	
804E	1B		MOV A, D	
804F	7A		ORA E	
8050	B3		JNZ REP	
8053	C2 4D 80		RET	
8054	C9			

ADDRESS	OPCODE	LABLE	MNEMONIC	COMMENTS
			ORG 8100H	
8100	97 83 97 93 87		DISTBL: ELECTRO-	
8105	13 F3 04		SYSTEMS.	
8108	D6 E6 D6 87 97			
810D	73 DE 00			

3. Program to scan the hex keypad and to display on Seven Segment Display using encode method.

```
CMD_PORT        EQU        81H
DATA_ PORT      EQU        80H
```

ADDRESS	OPCODE	LABLE	MNEMONIC	COMMENTS
8000	3E 00		MVI A, 00H	
8002	D3 81		OUT 81H	
8004	3E 90		MVI A, 90H	
8006	D3 81		OUT 81H	
8008	0E 08		MVI C, 08H	
800A	3E 00	CLEAR:	MVI A, 00H	; To clear all the digits.
800C	D3 80		OUT 80H	
800E	0D		DCR C	
800F	79		MOV A, C	
8010	FE 00		CPI 00H	
8012	C2 0A 80		JNZ CLEAR	
8015	DB 81	BACK:	IN 81H	; Read 8279 status.
8017	E6 07		ANI 07H	; is character available.
8019	CA 15 80		JZ BACK	
801C	21 00 81		LXI H, DISTBL	
801F	3E 40		MVI A, 40H	; Read FIFO.
8021	D3 81		OUT 81H	
8023	DB 80		IN 80H	
8025	E6 1F		ANI IFH	; Mask shift and control keys.
8027	6F		MOV L, A	
8028	3E 94		MVI A, 94H	; Address to display 0.
802A	D3 81		OUT 81H	
802C	3E F3		MVI A, 0F3H	; Address to display scanned
802E	D3 80		OUT 80H	; value.
8030	3E 95		MVI A, 95H	
8032	D3 81		OUT 81H	
8034	7E		MOV A, M	
8035	D3 80		OUT 80H	
8037	C3 15 80		JMP BACK	
8100	F3 60 B5 F4 66		DISTBL: 0 1 2 3	
8105	D6 D7 70 F7		4 5 6 7	
8109	76 77 C7 93 E5		8 9 A B	
810E	97 17 00		C D E F.	
8111	76 77 C7 93 E5			
8116	97 17 0			

5.0 DEMONSTRATION PROGRAMS FOR 8086 SERIES KITS
5A. EXAMPLE PROGRAMS FOR ESA 86/88-2 TRAINER

1.PROGRAM TO DISPLAY THE VALUE OF THE KEY PRESSED IN THE DISPLAY FIELD USING ENCODE METHOD

COMMAND PORT = 0082H
DATA PORT = 0080H

```
ADDRESS     OPCODE        LABEL      MNEMONICS          COMMENTS

0000:2000                            ORG 2000H
0000:2000   BE 00 30                 MOVW SI,#3000
0000:2003   B0 00                    MOVB AL,#00
0000:2005   BA 82 00                 MOVW DX,#82        ;INITIALIZE 8279
0000:2008   EE                       OUTB DX,AL
0000:2009   B0 90                    MOVB AL,#90
0000:200B   EE                       OUTB DX,AL
0000:200C   B9 08 00                 MOVW CX,#08
0000:200F   B0 00          CLEAR:    MOVB AL,#00        ;CLEAR THE
0000:2011   BA 80 00                 MOVW DX,#80        ;DISPLAY
0000:2014   EE                       OUTB DX,AL
0000:2015   E2 F8                    LOOP 200F
0000:2017   BA 82 00       BACK:     MOVW DX,#82
0000:201A   EC                       INB AL,DX
0000:201B   24 07                    ANDB AL,#07
0000:201D   74 F8                    JZ 2017
0000:201F   BE 00 30                 MOVW SI,#3000
0000:2022   B0 40                    MOVB AL,#40        ;READ FIFO
0000:2024   EE                       OUTB DX,AL
0000:2025   BA 80 00                 MOVW DX,#80
0000:2028   EC                       INB AL,DX
0000:2029   24 1F                    ANDB AL,#1F
0000:202B   B4 00                    MOVB AH,#00
0000:202D   89 C1                    MOVW CX,AX
0000:202F   03 F1*                   ADDW SI,CX
0000:2031   BA 82 00                 MOVW DX,#82
0000:2034   B0 94                    MOVB AL,#94        ;ADDRESS TO
0000:2036   EE                       OUTB DX,AL         ;DISPLAY 0
0000:2027   BA 80 00                 MOVW DX,#80
0000:203A   B0 F3                    MOVB AL,#F3
0000:203C   EE                       OUTB DX,AL
0000:203D   BA 82 00                 MOVW DX,#82
0000:2040   B0 95                    MOVB AL,#95
0000:2042   EE                       OUTB DX,AL
0000:2043   BA 80 00                 MOVW DX,#80
0000:2046   8A 04                    MOVB AL,[SI]
0000:2048   EE                       OUTB DX,AL
0000:2049   E9 CB FF                 JMP 2017
0000:3000                            ORG 3000H
0000:3000   F3 60 B5 F4 66   LOOP:   DB 0F3H,60H,0B5H,0F4H,66H
0000:3005   D6 D7 70 F7 76           DB 0D6H,0D7H,70H,0F7H,76H
0000:300A   77 C7 93 E5 97           DB 77H,0C7H,93H,0E5H,97H
0000:300F   17 00 76 77 C7           DB 17H,00H,76H,77H,0C7H
0000:3014   93 E5 97 17 00           DB 93H,0E5H,97H,17H,00H
```

2. PROGRAM TO DISPLAY ESA IM DISPLAY FIELD USING DECODE METHOD. EXECUTE PROGRAM FROM 2000H.

```
0000: 2000                    ORG 2000H         ;Clear Display
0000: 2000  B0 90             MOVB AL,#90
0000: 2002  BA 82 00          MOVW DX,#82
0000: 2005  EE                OUTB DX,AL
0000: 2006  B0 00             MOVB AL,#00       ;Left entry decoded
0000: 2008  EE                OUTB DX,AL        ;scan keyboard
0000: 2009  B9 08 00          MOVW CX,#08
0000: 200C  B0 00       RPT:  MOVB AL,#00
0000: 200E  BA 80 00          MOVW DX,#80
0000: 2011  EE                OUTB DX,AL
0000: 2012  E2 F8             LOOP 200C
0000: 2014  B9 04 00          MOVW CX,#04
0000: 2017  B8 00 00          MOVW AX,#00
0000: 201A  BE 00 21          MOVW SI,#2100     ;Display ESA
0000: 201D  8A 04       LOOP: MOVB AL,[SI]
0000: 201F  EE                OUTB DX,AL
0000: 2020  46                INCW SI
0000: 2021  E2 FA             LOOP 201D
0000: 2023  CC                INT 3

0000: 2100                    ORG 2100H
0000: 2100  04 97 D6 77       DB 04H,97H,D6H,77H
0000: 2106  04 04 00          DB 04H,04H,00H
```

3. PROGRAM TO DISPLAY ESA IN DISPLAY FIELD USING ENCODE METHOD.

```
0000: 2000                    ORG 2000H         ;Clear Display
0000: 2000  B0 90             MOVB AL,#90
0000: 2002  BA 82 00          MOVW DX,#82
0000: 2005  EE                OUTB DX,AL
0000: 2006  B0 00             MOVB AL,#00       ;Left entry encoded
0000: 2008  EE                OUTB DX,AL        ; scan keyboard
0000: 2009  B9 08 00          MOVW CX,#08
0000: 200C  B0 00       RPT:  MOVB AL,#00
0000: 200E  BA 80 00          MOVW DX,#80
0000: 2011  EE                OUTB DX,AL
0000: 2012  E2 F8             LOOP 200C
0000: 2014  B9 08 00          MOVW CX,#08
0000: 2017  B8 00 00          MOVW AX,#00
0000: 201A  BE 00 21          MOVW SI,#2100     ; Display ESA
0000: 201D  8A 04       LOOP : MOVB AL,[SI]
0000: 201F  EE                OUTB DX,AL
0000: 2020  46                INCW SI
0000: 2021  E2 FA             LOOP 201D
0000: 2023  CC                INT 3

0000: 2100                    ORG 2100H
0000: 2100  04 97 D6 77       DB 04H,97H,D6H,77H
```

```
0000: 2106  04 04 00          DB 04H,04H,00H
```

5B.EXAMPLE PROGRAMS FOR ESA 86/88-3 TRAINER

1.PROGRAM TO DISPLAY THE VALUE OF THE KEY PRESSED IN THE DISPLAY FIELD USING ENCODE METHOD

COMMAND PORT = 0082H
DATA PORT = 0080H

```
ADDRESS     OPCODE        LABEL      MNEMONICS          COMMENTS

0000:2000                            ORG 2000H
0000:2000   BE 00 30                 MOVW SI,3000
0000:2003   B0 00                    MOVB AL,00
0000:2005   BA 82 00                 MOVW DX,82         ;INITIALIZE 8279
0000:2008   EE                       OUTB DX,AL
0000:2009   B0 90                    MOVB AL,90
0000:200B   EE                       OUTB DX,AL
0000:200C   B9 08 00                 MOVW CX,08
0000:200F   B0 00         CLEAR:     MOVB AL,00         ;CLEAR          THE
0000:2011   BA 80 00                 MOVW DX,80         ;DISPLAY
0000:2014   EE                       OUTB DX,AL
0000:2015   E2 F8                    LOOP 200F
0000:2017   BA 82 00      BACK:      MOVW DX,82
0000:201A   EC                       INB AL,DX
0000:201B   24 07                    ANDB AL,07
0000:201D   74 F8                    JZ 2017
0000:201F   BE 00 30                 MOVW SI,3000
0000:2022   B0 40                    MOVB AL,40         ;READ FIFO
0000:2024   EE                       OUTB DX,AL
0000:2025   BA 80 00                 MOVW DX,80
0000:2028   EC                       INB AL,DX
0000:2029   24 1F                    ANDB AL,1F
0000:202B   B4 00                    MOVB AH,00
0000:202D   8B C8                    MOVW CX,AX
0000:202F   03 F1                    ADDW SI,CX
0000:2031   BA 82 00                 MOVW DX,82
0000:2034   B0 94                    MOVB AL,94         ;ADDRESS TO
0000:2036   EE                       OUTB DX,AL         ;DISPLAY 0
0000:2027   BA 80 00                 MOVW DX,80
0000:203A   B0 F3                    MOVB AL,F3
0000:203C   EE                       OUTB DX,AL
0000:203D   BA 82 00                 MOVW DX,82
0000:2040   B0 95                    MOVB AL,95
0000:2042   EE                       OUTB DX,AL
0000:2043   BA 80 00                 MOVW DX,80
0000:2046   8A 04                    MOVB AL,[SI]
0000:2048   EE                       OUTB DX,AL
0000:2049   E9 CB FF                 JMP 2017

0000:3000                            ORG 3000H
0000:3000   F3 60 B5 F4 66   LOOP:   DB 0F3H,60H,0B5H,0F4H,66H
0000:3005   D6 D7 70 F7 76          DB 0D6H,0D7H,70H,0F7H,76H
0000:300A   77 C7 93 E5 97          DB 77H,0C7H,93H,0E5H,97H
0000:300F   17 00 76 77 C7          DB 17H,00H,76H,77H,0C7H
```

```
0000:3014    93 E5 97 17 00          DB 93H,0E5H,97H,17H,00H
```

2. PROGRAM TO DISPLAY ESA IN DISPLAY FIELD USING DECODE METHOD. EXECUTE PROGRAM FROM 2000H.

```
0000: 2000                      ORG 2000          ;Clear Display
0000: 2000  B0 90               MOVB AL,90
0000: 2002  BA 82 00            MOVW DX,82
0000: 2005  EE                  OUTB DX,AL
0000: 2006  B0 00               MOVB AL,00        ;Left entry decoded
0000: 2008  EE                  OUTB DX,AL        ;scan keyboard
0000: 2009  B9 08 00            MOVW CX,08
0000: 200C  B0 00         RPT:  MOVB AL,00
0000: 200E  BA 80 00            MOVW DX,80
0000: 2011  EE                  OUTB DX,AL
0000: 2012  E2 F8               LOOP 200C
0000: 2014  B9 06 00            MOVW CX,06
0000: 2017  B8 00 00      LOOP1:MOVW AX,00
0000: 201A  BE 00 21            MOVW SI,2100      ;Display ESA
0000: 201D  8A 04               MOVB AL,[SI]
0000: 201F  EE                  OUTB DX,AL
0000: 2020  46                  INCW SI
0000: 2021  E2 F4               LOOP 2017
0000: 2023  CC                  INT 3

0000: 2100                      ORG 2100
0000: 2100  04 97 D6 77         DB 04H,97H,D6H,77H
0000: 2106  04 04 00            DB 04H,04H,00H
```

3. PROGRAM TO DISPLAY ESA IN DISPLAY FIELD USING ENCODE METHOD.

```
0000: 2000                      ORG 2000          ;Clear Display
0000: 2000  B0 90               MOVB AL,90
0000: 2002  BA 82 00            MOVW DX,82
0000: 2005  EE                  OUTB DX,AL
0000: 2006  B0 00               MOVB AL,00        ;Left entry encoded
0000: 2008  EE                  OUTB DX,AL        ;scan keyboard
0000: 2009  B9 08 00            MOVW CX,08
0000: 200C  B0 00         RPT:  MOVB AL,00
0000: 200E  BA 80 00            MOVW DX,80
0000: 2011  EE                  OUTB DX,AL
0000: 2012  E2 F8               LOOP 200C
0000: 2014  B9 06 00            MOVW CX,06
0000: 2017  B8 00 00      LOOP1:MOVW AX,00
0000: 201A  BE 00 21            MOVW SI,2100      ;Display ESA
0000: 201D  8A 04               MOVB AL,[SI]
0000: 201F  EE                  OUTB DX,AL
0000: 2020  46                  INCW SI
0000: 2021  E2 F4               LOOP 2017
0000: 2023  CC                  INT 3

0000: 2100                      ORG 2100
0000: 2100  04 97 D6 77         DB 04H,97H,D6H,77H
0000: 2106  04 04 00            DB 04H,04H,00H
```

5C. DEMONSTRATION PROGRAMS FOR ESA 86/88E TRAINER

8279 REGISTER ADDRESSING

The addresses for 8279 registers on this card for use with **ESA 86/88E** Trainer are as follows:

COMMAND PORT – FFC0H
DATA PORT – FFC2H

1. Program to display '-**ESA PVT LTD**' using Decode method.

```
ADDRESS    OP-CODES   LABELS     MNEMONICS        COMMENTS
0000: 2000  B9 08 00              MOVW  CX,08
0000: 2003  B0 00                 MOVB  AL,00
0000: 2005  BA C2 FF              MOVW  DX,0FFC2    ;Routine to clear
0000: 2008  EE                    OUTB  DX,AL       ;all displays
0000: 2009  B0 90                 MOVB  AL,90
0000: 200B  EE                    OUTB  DX,AL
0000: 200C  B0 00          RPT:   MOVB  AL,00
0000: 200E  BA C0 FF              MOVW  DX,0FFC0
0000: 2011  EE                    OUTB  DX,AL
0000: 2012  E2 F8                 LOOP  RPT
0000: 2014  BA C2 FF              MOVW  DX,0FFC2   ;8 8-bit Character
0000: 2017  B0 01                 MOVB  AL,01      ;display Left entry
0000: 2019  EE                    OUTB  DX,AL      ;Decoded scan keybd
0000: 201A  BA C2 FF              MOVW  DX,0FFC2
0000: 201D  B0 90                 MOVB  AL,90      ;Write to 8279
0000: 201F  EE                    OUTB  DX,AL      ;display RAM
0000: 2020  BE 00 21       BCK:   MOVW  SI,2100    ;Routine to Display
0000: 2023  B9 04 00              MOVW  CX,04      ;'-ESA'
0000: 2026  8A 04          BC0:   MOVB  AL,[SI]
0000: 2028  BA C0 FF              MOVW  DX,0FFC0
0000: 202B  EE                    OUTB  DX,AL
0000: 202C  46                    INCW  SI
0000: 202D  E2 F7                 LOOP  BCO
0000: 202F  E8 27 00              CALL  DLY        ;Provide some delay
0000: 2032  BE 04 21              MOVW  SI,2104    ;Routine to display
0000: 2035  B9 04 00              MOVW  CX,04      ;' PVT'
0000: 2038  8A 04          BC1:   MOVB  AL,[SI]
0000: 203A  BA C0 FF              MOVW  DX,0FFC0
0000: 203D  EE                    OUTB  DX,AL
0000: 203E  46                    INCW  SI
0000: 203F  E2 F7                 LOOP  BC1
0000: 2041  E8 15 00              CALL  DLY        ;Provide some delay
0000: 2044  BE 08 21              MOVW  SI,2108    ;Routine to display
0000: 2047  B9 04 00              MOVW  CX,04      ;'LTD'
0000: 204A  8A 04          BC2:   MOVB  AL,[SI]
0000: 204C  BA C0 FF              MOVW  DX,0FFC0
0000: 204F  EE                    OUTB  DX,AL
0000: 2050  46                    INCW  SI
```

```
0000: 2051  E2 F7                   LOOP  BC2
0000: 2053  E8 03 00                CALL DLY    ;Provide some delay
0000: 2056  E9 C7 FF                JMP BCK     ;Repeat continuously
0000: 2059  51          DLY:        PUSH CX     ;Delay routine
0000: 205A  B9 00 00                MOVW CX,0000
0000: 205D  E2 FE                   LOOP 205D
0000: 205F  E2 FE                   LOOP 205F
0000: 2061  59                      POP CX
0000: 2062  C3                      RET

                              ORG 2100    ;Display loop-up
0000: 2100  04 97                   DB  04,97   ;table
0000: 2102  D6 77                   DB  0D6,77
0000: 2104  00 37                   DB  00,37
0000: 2106  E3 87                   DB  0E3,87
0000: 2108  00 83                   DB  00,83
0000: 210A  87 E5                   DB  87,0E5
```

2. Program to display '**ELECTRO SYSTEMS. INDIA -**' using Encode method.

```
ADDRESS     OP-CODES  LABELS    MNEMONICS       COMMENTS
0000: 2000  B9 08 00              MOVW  CX,08
0000: 2003  B0 00                 MOVB  AL,00
0000: 2005  BA C2 FF              MOVW  DX,0FFC2  ;Routine to clear
0000: 2008  EE                    OUTB  DX,AL     ;all displays
0000: 2009  B0 90                 MOVB  AL,90
0000: 200B  EE                    OUTB  DX,AL
0000: 200C  B0 00         RPT:    MOVB  AL,00
0000: 200E  BA C0 FF              MOVW  DX,0FFC0
0000: 2011  EE                    OUTB  DX,AL
0000: 2012  E2 F8                 LOOP  RPT
0000: 2014  BA C2 FF              MOVW  DX,0FFC2  ;8 8-bit Character
0000: 2017  B0 10                 MOVB  AL,10     ;display Right
0000: 2019  EE                    OUTB  DX,AL     ;entry, Encoded
0000: 201A  BA C2 FF              MOVW  DX,0FFC2  ;scan keyboard
0000: 201D  B0 90                 MOVB  AL,90     ;Write to 8279
0000: 201F  EE                    OUTB  DX,AL     ;display RAM
0000: 2020  BE 00 21      BCK:    MOVW  SI,2100   ;Routine to display
0000: 2023  B9 08 00              MOVW  CX,08     ;'ELECTRO'
0000: 2026  8A 04         BC0:    MOVB  AL,[SI]
0000: 2028  BA C0 FF              MOVW  DX,0FFC0
0000: 202B  EE                    OUTB  DX,AL
0000: 202C  46                    XNCW  SI
0000: 202D  E8 23 00              CALL  DLY       ;Provide some delay
0000: 2030  E2 F4                 LOOP  BC0       ;between characters
0000: 2032  B9 08 00              MOVW  CX,08     ;Routine to display
0000: 2035  8A 04         BCl:    MOVB  AL,[SI]   ;'SYSTEMS.'
0000: 2037  BA C0 FF              MOVW  DX,0FFC0
0000: 203A  EE                    OUTB  DX,AL

0000:203B   46                    INCW  SI
0000:203C   E8 14 00              CALL  DLY      ;Provide some delay
0000:203F   E2 F4                 LOOP  BC1      ;between characters
```

```
0000:2041    B9 08 00              MOVW  CX,08     ;Routine to display
0000:2044    8A 04       BC2:      MOVB  AL,[SI]   ;'INDIA – `
0000:2046    BA C0 FF              MOVW  DX,0FFC0
0000:2049    EE                    OUTB  DX,AL
0000:204A    46                    INCW  SI
0000:204B    E8 05 00              CALL  DLY       ;Provide some delay
0000:204E    E2 F4                 LOOP  BC2       ;between characters
0000:2050    E9 CD EF              JMP   BCK       ;Repeat infinitely

0000:2053   51           DLY:     PUSH  CX        ;Delay routine
0000:2054   B9 00 00              MOVW  CX,0000
0000:2057   E2 FE                 LOOP  2057
0000:2059   59                    POP   CX
0000:205A   C3                    RET

0000:2100                         ORG 2100        ;Display look-up
0000:2100   97 83 97 93           DB 97,83,97,93  ;table
0000:2104   87 13 F3 00           DB 87,13,0F3,00
0000:2108   D6 E6 D6 87           DB 0D6,0E6,0D6,87
0000:210C   97 73 DE 00           DB 97,73,0DE,00
0000:2110   60 73 E5 60           DB 60,73,0E5,60
0000:2114   77 00 04 00           DB 77,00,04,00
```

3. Program to scan the Hex keypad and to display the code on the Seven Segment display using Encode method

```
ADDRESS    OP-CODES      LABELS   MNEMONICS       COMMENTS

0000: 2000  BB 00 00              MOVW  BX,00
0000: 2003  BA C2 FF              MOVW  DX,0FFC2
0000: 2006  B0 00                 MOVB  AL,00
0000: 2008  EE                    OUTB  DX,AL       ;Routine to clear
0000: 2009  B0 90                 MOVB  AL,90       ;all display LEDs
0000: 200B  EE                    OUTB  DX,AL
0000: 200C  B9 08 00              MOVW  CX,08
0000: 20OF  B0 00                 MOVB  AL,00
0000: 2011  BA C0 FF              MOVW  DX,0FFC0
0000: 2014  EE            RPT:    OUTB  DX,AL
0000: 2015  E2 FD                 LOOP  RPT
0000: 2017  BE 50 20      BCK:    MOVW  SI,2050
0000: 201A  BA C2 FF              MOVW  DX,0EFC2    ;Read 8279 status
0000: 201D  EC            KEY:    INB   AL,DX       ;to chock if any
0000: 201E  24 07                 ANDB  AL,07       ;character is
0000: 2020  74 FB                 JZ    KEY         ;available
0000: 2022  B0 40                 MOVB  AI,40
0000: 2024  EE                    OUTB  DX,AL
0000: 2025  BA C0 FF              MOVW  DX,0FFC0    ;Read FIFO RAM.
0000: 2028  EC                    INB   AL,DX       ;Mask SIFT and


0000: 2029 24 1F                  ANDB  AL,1F       ;CTRL keys
0000: 202B 8A D8                  MOVB  BL,AL       ;Point to key
0000: 202D 03 F3                  ADDW  SI,BX       ;value
0000: 202F BA C2 FF               MOVW  DX,0FFC2    ;Address to
```

```
0000: 2032 B0 94                MOVB  AL,94       ; display 0
0000: 2034 EE                   OUTB  DX,AL
0000: 2035 BA C0 FF             MOVW  DX,0FFC0
0000: 2038 B0 F3                MOVB  AL,F3
0000: 203A EE                   OUTB  DX,AL

0000: 203B BA C2 FF             MOVW  DX,0FFC2    ;Address to
0000: 203E B0 95                MOVB  AL,95       ;display scanned
0000: 2040 EE                   OUTB  DX,AL       ;value
0000: 2041 BA C0 FF             MOVW  DX,0FFC0
0000: 2044 8A 04                MOVB  AL,[SI]
0000: 2046 EE                   OUTB  DX,AL
0000: 2047 E9 CD FF             JMP   BCK

                                ORG   2050        ;Scan key values
0000: 2050 F3 60 B5 F4          DB 0F3,60,0B5,0F4 ;look-up table
0000: 2054 66 D6 D7 70          DB 66,0D6,0D7,70
0000: 2058 F7 76 77 C7          DB 0F7,76,77,0C7
0000: 205C 93 E5 97 17          DB 93,0E5,97,17
```

6.0 DEMONSTRATION PROGRAMS FOR 8051 SERIES KITS.

6A. EXAMPLE PROGRAMES FOR ESA 31/51 TRAINER

1. PROGRAM TO DISPLAY " ESA " IN THE DISPLAY FEILD OF THE STUDY CARD USING ENCODE METHOD. EXECUTE PROGRAM FROM 8000H. PLACE JUMPER JP1 IN TRAINER.

```
                CMD   _PORT EQU   F181H
                DATA  _PORT EQU   F180H

8000                        ORG 8000H
8000  90 F1 81             MOV DPTR,#F181
8003  74 FF                MOV A,#FF         ;Divide CLK FREQ
8005  F0                   MOVX @DPTR,A
8006  7A 90                MOV R2,#90
8008  7B 00                MOV R3,#00        ;Initialize 8279
800A  90 F1 81             MOV DPTR,#F181
800D  74 90                MOV A,#90         ;Left entry,
800F  F0                   MOVX @DPTR,A      ;Encoded
8010  74 00                MOV A,#00         ;scan keyboard
8012  F0                   MOVX @DPTR,A
8013  78 08                MOV R0,#08
8015  74 00       START:   MOV A,#00
8017  90 F1 80             MOV DPTR,#F180
801A  F0                   MOVX @DPTR,A
801B  18                   DEC R0
801C  B8 00 F6             CJNE R0,#0,8015
801F  79 00                MOV Rl,#00
8021  90 90 00             MOV DPTR,#9000
8024  E4                   CLR A
8025  93          START1:  MOVC A,@A+DPTR    ;Reading Table
8026  90 F1 80             MOV DPTR,#F180
8029  F0                   MOVX @DPTR,A
802A  09                   INC Rl
802B  90 90 00             MOV DPTR,#9000
```

```
802E  E9                        MOV A,R1
802F  B9 06 F3                  CJNE Rl,#06,8025
8032  80 FE                    SJMP 8032

9000                            ORG 9000H
9000  04 97 D6    TABLE:        DB 04H,97H,D6H    ;Display ESA
9003  77 04 04                  DB 77H,04H,04H
9006  00                        DB 00H
```

2. PROGRAM TO DISPLAY " ESA " IN THE DISPLAY FEILD OF THE STUDY CARD USING DECODE METHOD.

```
                        CMD_PORT    EQU   F181H
                        DATA_PORT   EQU   F180H

8000                                ORG 8000H
8000  90 F1 81                      MOV DPTR,#F181
8003  74 FF                        MOV A,#FF         ;Divide CLK FREQ
8005  F0                           MOVX @DPTR,A
8006  7A 90                        MOV R2,#90
8008  7B 00                        MOV R3,#00        ;Initialize 8279
800A  90 F1 81                     MOV DPTR,#F181
800D  74 90                        MOV A,#90         ;Right entry,
800F  F0                           MOVX @DPTR,A      ;Decoded
8010  74 11                        MOVA,#11H         ;scan keyboard
8012  F0                           MOVX @DPTR,A
8013  78 08                        MOV R0,#08
8015  74 00               START:   MOV A,#00
8017  90 F1 80                     MOV DPTR,#F180
801A  F0                           MOVX @DPTR,A
801B  18                           DEC R0
801C  B8 00 F6                     CJNE R0,#0,8015
801F  79 00                        MOV Rl,#00
8021  90 90 00                     MOV DPTR,#9000
8024  E4                           CLR A
8025  93                  START1:  MOVC A,@A+DPTR    ;Reading Table
8026  90 F1 80                     MOV DPTR,#F180
8029  F0                           MOVX @DPTR,A
802A  09                           INC Rl
8Q2B  90 90 00                     MOV DPTR,#9000
802E  E9                           MOV A,R1
802F  B9 04 F3                     JNE Rl,#04,8025
8032  80 FE                       SJMP 8032

9000                               ORG  9000H
9000  04 97 D6          TABLE:     DB 04H,97H,D6H    ;display ESA
9003  77 04 04                     DB 77H,04H,04H
9006  00                           DB 00H
```

3. PROGRAM TO DISPLAY THE VALUE OF THE KEY PRESSED IN ENCODE METHOD.

```
                        CMD_PORT     EQU   F181H
                        DATA_ PORT   EQU   FI80H

8000                                 ORG 8000H
8000        75 81 07                 MOV SP,#07
8003        90 F1 81                 MOV DPTR,#F181
8006        74 FF                    MOV A,#FF          ;Divide CLK FREQ
8008        FO                       MOVX @DPTR,A
8009        74 00                    MOV A,#00
800B        90 F1 81                 MOV DPTR,#F181
800E        7A F1                    MOV R2,#F1
8010        79 80                    MOV Rl,#80
8012        7C 90                    MOV R4,#90
8014        7B 00                    MOV R3,#00
8016        F0                       MOVX @DPTR,A
8017        74 90                    MOV A,#90          ;Initialize 8279
8019        F0                       MOVX @DPTR,A
801A        78 08                    MOV R0,#08
801C        74 00          CLEAR:    MOV A,#00
8Q1E        90 F1 80                 MOV DPTR,#F180     ;Clear Display
8021        F0                       MOVX @DPTR,A
8022        18                       DEC R0
8023        E8                       MOV A,R0
8024        B4 00 F5                 CJNE A,#00,801C
8027        90 F1 81       BACK:     MOV DPTR,#F181
802A        E0                       MOVX A,@DPTR
802B        54 07                    ANL A,#07
802D        60 F8                    JZ 8027
802F        90 F1 81                 MOV DPTR,#F181
8032        74 40                    MOV A,#40
8034        F0                       MOVX @DPTR,A
8035        C0 83                    PUSH 83            ;Push DPH
8037        C0 82                    PUSH 82            ;Push DPL
8039        8A 83                    MOV 83,R2          ;Mov R2 to DPH
803B        89 82                    MOV 82,Rl          ;Mov Rl to DPL
803D        F0                       MOVX @DPTR,A
803E        E0                       MOVX A,@DPTR
803F        54 1F                    ANL A,#1F
8041        FD                       MOV R5,A
8042        D0 82                    POP 82             ;Pop DPL
8044        D0 83                    POP 83             ;Pop DPH
8046        74 94                    MOV A,#94
8048        F0                       MOVX @DPTR,A
8049        74 F3                    MOV A,#F3
804B        C0 83                    PUSH 83            ;Push DPH
804D        C0 82                    PUSH 82            ;Push DPL
804F        8A 83                    MOV 83,R2          ;Mov R2 to DPH
8051        89 82                    MOV 82,Rl          ;Mov Rl to DPL
8053        F0                       MOVX @DPTR,A
8054        74 95                    MOV A,#95
8056        D0 82                    POP 82             ;Pop DPL
8058        D0 83                    POP 83             ;Pop DPH
```

```
805A        F0                      MOVX @DPTR,A      ;Reading Table
805B        8C 83                   MOV 83,R4         ;Mov R4 to DPH
805D        8D 82                   MOV 82,R5         ;Mov R5 to DPL
805F        E4                      CLR A
8060        93                      MOVC A,@A+DPTR
8061        90 F1 80                MOV DPTR,#F180
8064        F0                      MOVX @DPTR,A
8065        0B                      INC R3
8066        02 80 27                LJMP 8027

9000                                ORG 9000H
9000        F3 60 B5    DISP:       DB F3H,60H,B5H
9003        F4 66 D6                DB F4H,66H,D6H
9006        D7 70 F7                DB D7H,70H,F7H
9009        76 77 C7                DB 76H,77H,C7H
900C        93 E5 97                DB 93H,E5H,97H
900F        17 00                   DB 17H,00H
9011        76 C7 93                DB 76H,C7H,93H
9014        E5 97 17                DB E5H,97H,17H
9017        00                      DB 00H
```

4.Example program for ESA 51E trainer to display the value of the key pressed on the display field of the study card using encode method. Execute program from 8000H.Place jumpers on the study card for encode mode as given in the first page.

```
8000                        ORG 8000H
8000  90 F1 81              MOV DPTR,#0F181H      ;Clk Divide
8003  74 3C                 MOV A,#03CH
8005  F0                    MOVX @DPTR,A
8006  74 00                 MOV A,#00H            ;Key & Disp Mode set
8008  F0                    MOVX @DPTR,A
8009  74 90                 MOV A,#90H
800B  F0                    MOVX @DPTR,A
800C  90 F1 80              MOV DPTR,#0F180H      ;Clear Disp
800F  E4                    CLR A
8010  78 06                 MOV R0,#06H
8012  F0              CLEAR:MOVX @DPTR,A
8013  D8 FD                 DJNZ R0,CLEAR
8015  7A 30           SET:  MOV R2,#30H
8017  90 F1 81              MOV DPTR,#0F181H      ;Check FIFO Status For Key
801A  E0              SCN:  MOVX A,@DPTR          ;Entry
801B  54 07                 ANL A,#07H
801D  60 FB                 JZ SCN
801F  EA                    MOV A,R2              ;FIFO Ram Address
8020  F0                    MOVX @DPTR,A
8021  15 82                 DEC DPL
8023  E0                    MOVX A,@DPTR
8024  54 1F                 ANL A,#1FH
8026  F9                    MOV R1,A
8027  74 94                 MOV A,#94H
8029  A3                    INC DPTR
802A  F0                    MOVX @DPTR,A
802B  74 F3                 MOV A,#0F3H
802D  15 82                 DEC DPL
802F  F0                    MOVX @DPTR,A
```

```
8030  74 95            MOV A,#95H
8032  A3               INC DPTR
8033  F0               MOVX @DPTR,A
8034  75 83 90         MOV DPH,#90H
8037  89 82            MOV DPL,Rl
8039  E4               CLR A
803A  93               MOVC A,@A+DPTR
803B  90 F1 80         MOV DPTR,#0F180H
803E  F0               MOVX @DPTR,A
803F  A3               INC DPTR
8040  0A               INC R2
8041  EA               MOV A,R2
8042  B4 38 D5         CJNE A,#38H,SCN
8045  02 80 15         LJMP SET
                       ORG 9000H
9000  F3 60 B5 F4 66   DB 0F3H,60H,B5H,F4H,66H
9005  D6 D7 70 F7 76   DB 0D6H,0D7H,70H,0F7H,76H
900A  77 C7            DB 77H,0C7H
900C  93 E5 97 17 00   DB 93H,97H,17H,00H
9011  76 C7 93 E5 97   DB 76H,0C7H,93H,0E5H,97H,
9016  17 00            DB 17H,00H
```